II CONGRESSO IBÉRICO DE ENTOMOLOGIA

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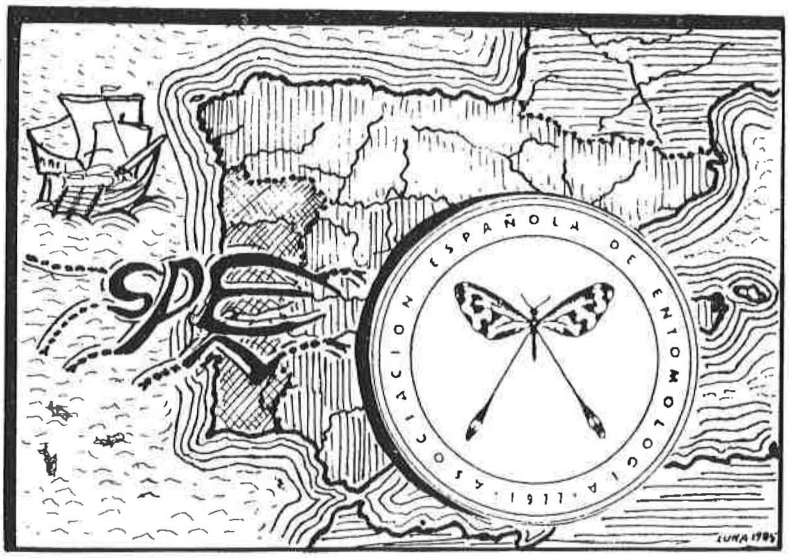

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ABSTRACT

An evaluation of the effect of the dry and frozen phases on the animal populations of a temporal pond.

RESUMEN

Se evalúa el efecto de la fase seca y del período de congelación sobre las poblaciones de una charca temporal.

Interest in temporal ponds is growing in part due to their peculiar fauna and to the adaptive resources these have developed (HARTLAND-ROWE,1972). More recently two other subjects attract attention to these small water bodies: first, their potential use as a test of ecological theory and, second their possibilities as an environmental education tool (CAMACHO Y COLS., 1982). An objective measure of this statement can be found in the contents of the S.I.L. (Societas Internationalis Limnologiae) publications. Until the last congress (France, 1983), there had not been a special section on small water bodies. We think this recent interest will intensify in the future.

The Iberian peninsula is very rich in temporal ponds (see ALONSO & COMELLES, 1984 for a tipification). Their diversity offers an ample spectrum of chemical contents, hydrological cycles and a wide range of sizes. Nevertheless, they are not well known, even in the field of faunistics (ALONSO, pers. comm.).

As part of an extensive study of the small water bodies of the sierra del Guadarrama, a mountain range in the north of Madrid, we have followed the annual cycle of a temporal pond located near the top of the sierra.

There are at least two phases, that could potentially alter the development of animals populating the pond: the dry phase and the frozen phase. The first is important in distinguishing which part of the annual stock of species remains in the dry mud in resistant stage, and which part must recolonize the pond every year. The frozen phase, depending on the severity of the winter, could temporally eliminate some species or favour some species at the expense of others.

MATERIAL AND METHODS

a) Description of the pond.

All data have been collected from a temporary autumnal pool (WIGGINS Y COLS, 1980; BALTANAS, in prep.) located in the Puerto de la Morcuera near Miraflores de la Sierra (Madrid) at 1,717 m. altitude.

The pool has an approximate surface area of 330 m^2 with a mean depth of 29 cm. (range: 15-30 cm.) when full of water.

The climate is predominantly windy and rainy for most of the year, but is hot in summer with temperatures rising as high as 33°C.

The vegetation around the pool is a typical subhygrophil prairie of <u>Nardus stricta</u> L.; the characteristic species found inside the pool are *Ranunculus peltatus* Schrank subsp. *saniculifolins* (viv) C.D.K., *Callitriche brutia* Petagna, *Alopecurus geniculatus* L. subsp.*fulvus* (Sm.)Trabut as well as filamentous algae, probably *Cladophora* sp. During the dry period (July to October) the pool basin was covered by *Alopecurus geniculatus* L. subsp. *fulvus* (Sm.) Trabut (Cirujano, pers. comm.).

b) Experimental design.

Several mud samples were collected from the dry basin in August, 1984 and stored at room temperature (18-22°C).

In January, 1985 400 gr. of mud were taken from one of these samples and mixed with desclorinated water in a plastic tray. Twenty days later (mean temperature 18°C) were separated using two metal sieves of 0.250 mm. and 0.063 mm. mesh. Organisms were identified and counted with a stereoscopic microscope (x16 and x25).

Another 90 gr were taken from the original sample and washed carefully. This was then analized as above. Because of the high numbers of some taxa we have done subsampling (LUND Y COLS.,1958; ELLIOT, 1971) to estimate the amount of the organisms in the mud. The results obtained both in the

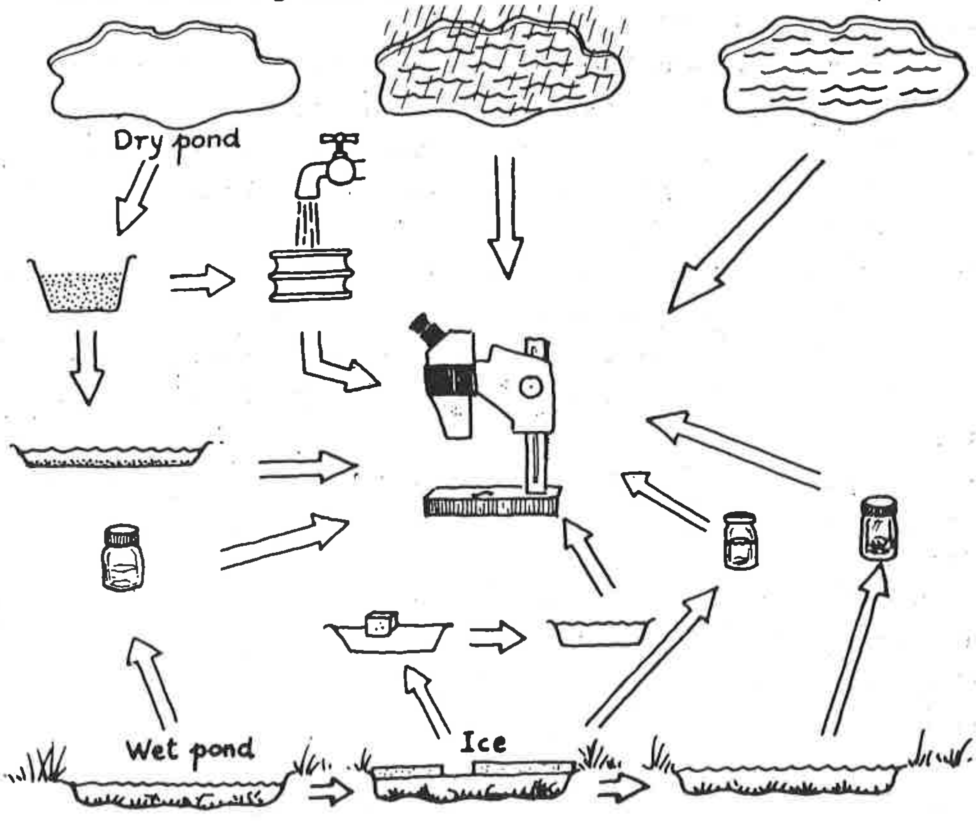

Fig. 1. The experimental design. See text for an explanation.

mud culture and the washed and counted sample were compared with samples taken from the pond after it had been filled by rainfall (see Fig.1).

During the wet period, freezing temperatures were reached on several winter days. Ice covered the pool in very thick layers from 2 to 25 cm. In February, 1984-1985, big ice-blocks were collected. Before carrying them to the laboratory the surface were scraped to remove those organisms that were attached to but not embedded in the ice. After melting (mean temperature 18°C) the water (50 l.) was filtered and the filtrated analized as above, live organisms were identified and counted as well as dead ones.

Samples taken with a net (mesh size 0.085 mm.) from the free standing water before, during and after the ice layer had covered the pool. These were fixed in formalin (4%) and processed as above.

RESULT AND DISCUSSION

Data on the dry stage and the frozen stage are presented separately.

a) The dry stage.

Only a few kinds of organisms could be detected as adults or near maturity, in the dry mud once washed.

The most abundant taxa were Ostracoda, Nematoda and some Cladocera. A few specimens of Tardigrada, terrestial mites and Rorifera were also found. However, there were large quantities of eggs and resting phases, mainly from Anostraca and Calnoida. Other structures could not be identified as either seeds or eggs.

Table I includes a qualitative as well a quantitative estimation of the most abundant organisms readily detectable in the mud, after washing and after 20 days of cultivation in the laboratory, and a quantitative estimation of the populations in the pond, just after filling and about 20 days later.

Fig. 2 displays the abundance trend of the main groups from the dry to the wet phase.

Of the two predominant groups in the dry phase, Ostracoda and Nematoda, the second one seems to recover as soon as the pool fills with water and then decrease in the following weeks. Ostracoda seems to follow a more regular rate of recovery and their numbers increase progresively in subsequent weeks.

A conflicting points concerns the appearance of copepods 20 days after the pond is filled. The resting stages in ciclopoid copepods are the last copepodids stages and the diapausing adult (Pennak, 1978). The number of Copepoda that appear after the pond is filled is very small, and high numbers are not present until 20 days later. It is more reasonable to relate this abundant trend to development than to the diapause stage. But the lack of Copepoda in the experimental mud is noticeable after 20 days of cultivation. At this point we are unable to document, wether the copepods in the pond spend the dry stage as copepodits, eggs or any other stage. Others groups, like Anostraca, are readily detectable as egg in the dry mud.

b) The frozen phase.

Table II includes those organisms that were present in the water when it froze. Almost all the groups are represented in the ice, but the proportion of individuals that are retained is exceedingly small in relation to the actual population underneath the ice-cap. Fig. 3 displays the abundance trend of the main groups during the frozen phase.

One interesting fact regarding the animals trapped in the ice, is that some remain alive after the ice has melted. These includes mainly Copepoda, Ostracoda and Chironomidae.

Resistance of aquatic invertebrates to freezing conditions seems to be a well documented fact (HOLMQUIST, 1973; DANELL, 1981; OLSSON, 1981). The physiological stage in which this animals endure the frozen period remains to be seen. The texture of the ice surrounding them at temperatures not much lower than 0°C could include some fluid areas.

Concerning the influence that the ice-cap has on the animals living in the free water, only harcticoid and chyrodids seem to be affected by the ice-cap period. The first suffer a progresive decrease in numbers. Moreover from eight specimens recovered from the ice, only one was alive. It could be that the low temperature are inhospitable to harpacticoids populations. On the contrary, chyrodids increase continuosly during the ice-cap period. Finally, chironomids increase initially and then decrease. A clear explanation for this process could not be found.

Oscillations in the other animal groups are not significant enough to warrant special explanation.

TABLE I

Description of the animal populations during the dry and wet phases. Numbers within brackets are quantitative estimates (for 60 l.) Others are percentages a) Pond, just filled./b) Pond at 20 days./c) Washed and counted at laboratory. /d) after 20 days at laboratory.

	a	b	c	d
CALANOIDA	0 (0)	0 (0)	0 (0)	0 (0)
CYCLOPOIDA	0.8 (3)	41.3 (1830)	0 (0)	0 (0)
HARPACTICOIDA	8.9 (33)	30.2 (1340)	0 (0)	0 (0)
CHYDORIDAE	0 (0)	0 (0)	4.6 (5)	4.1 (3)
MACHROTRICHIDAE	0 (0)	0.7 (30)	0 (0)	12.2 (9)
OSTRACODA	16.7 (62)	3.5 (157)	79.9 (88)	52.7 (39)
CHIRONOMIDAE	0 (0)	0 (0)	0 (0)	0 (0)
CULICIDAE	0 (0)	0 (0)	0 (0)	0 (0)
NEMATODA	73.5 (272)	22.8 (1010)	15.5(17)	-
ANOSTRACA	0 (0)	0.3 (13)	0 (0)	31.1 (23)

TABLE II

Description of the animal populations during the frozen phase. Numbers within brackets are quantitative estimates (for 60 l.), the others are percentages.

a) before freezing./b) free water under ice./c) ice./d) pond after melting.

	a	b	c	d
CALANOIDA	11.4(230)	42.6(1000)	0(0)	26.4(344)
CYCLOPOIDA	0.7(15)	0.2(5)	0(0)	1.2(16)
HARPACTICOIDA	58.4(1180)	9.8(230)	5.5(1)	6.5(85)
CHYDORIDAE	2.2(45)	16.6(390)	0(0)	40.3(526)
MACHROTRICHIDAE	2(40)	0.1(3)	0(0)	1.2(16)
OSTRACODA	13.4(270)	5.5(128)	11.1(2)	11(144)
CHIRONOMIDAE	3.2(65)	22.6(530)	5.5(1)	8.7(13)
CULICIDAE	1.7(35)	1.3(31)	0(0)	1.6(21)
NEMATODA	6.2(125)	0.8(18)	0(0)	2.7(35)
ANOSTRACA	0.7(15)	0.1(3)	0(0)	0.3(4)
NAUPLIUS COPEPODA	-	-	72.2(14)	-

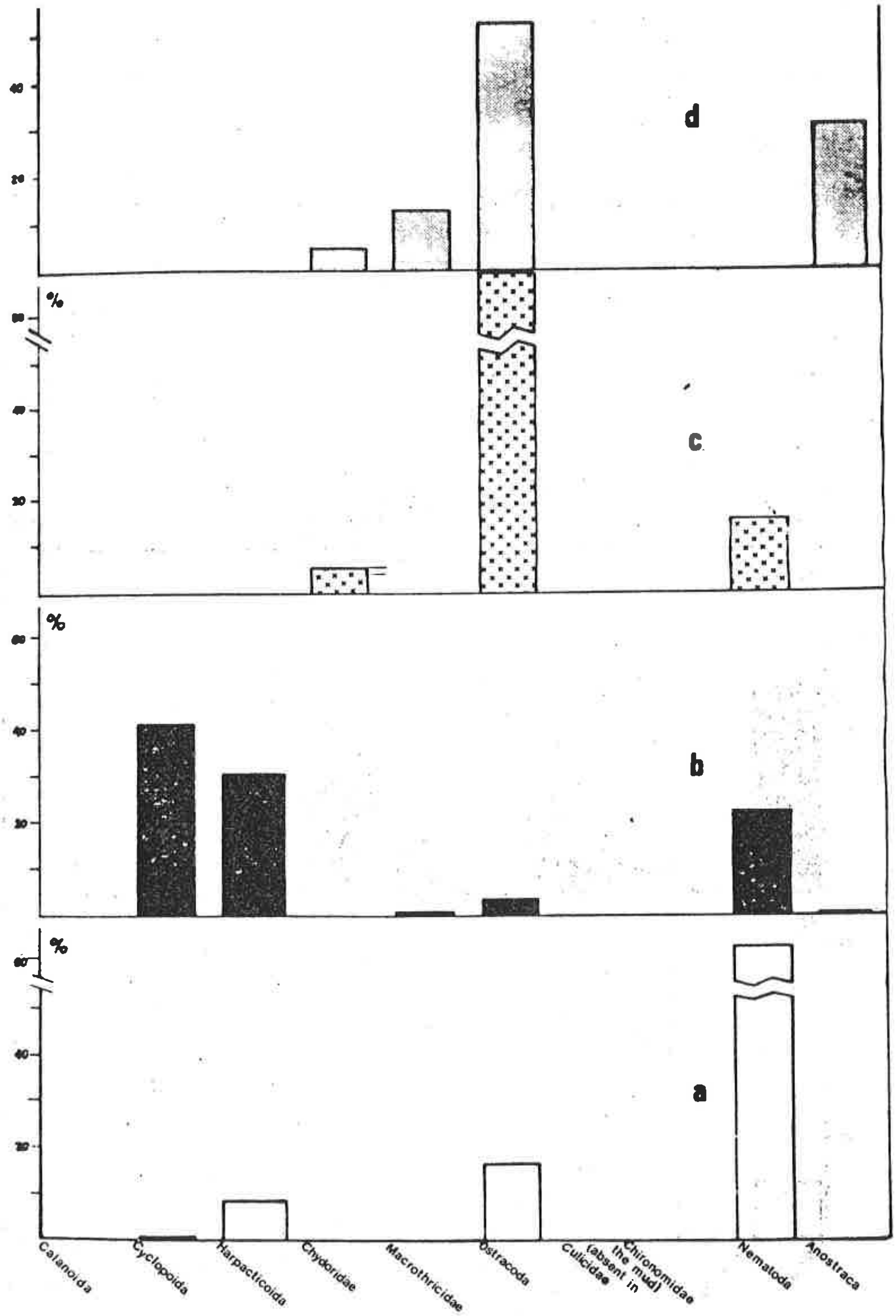

Fig. 2. Abundance trend of the main groups during the dry-wet phase. a)Pond, just filled./b)Pond,20 days later./c)Washed and counted at lab./ d)After 20 days at lab.

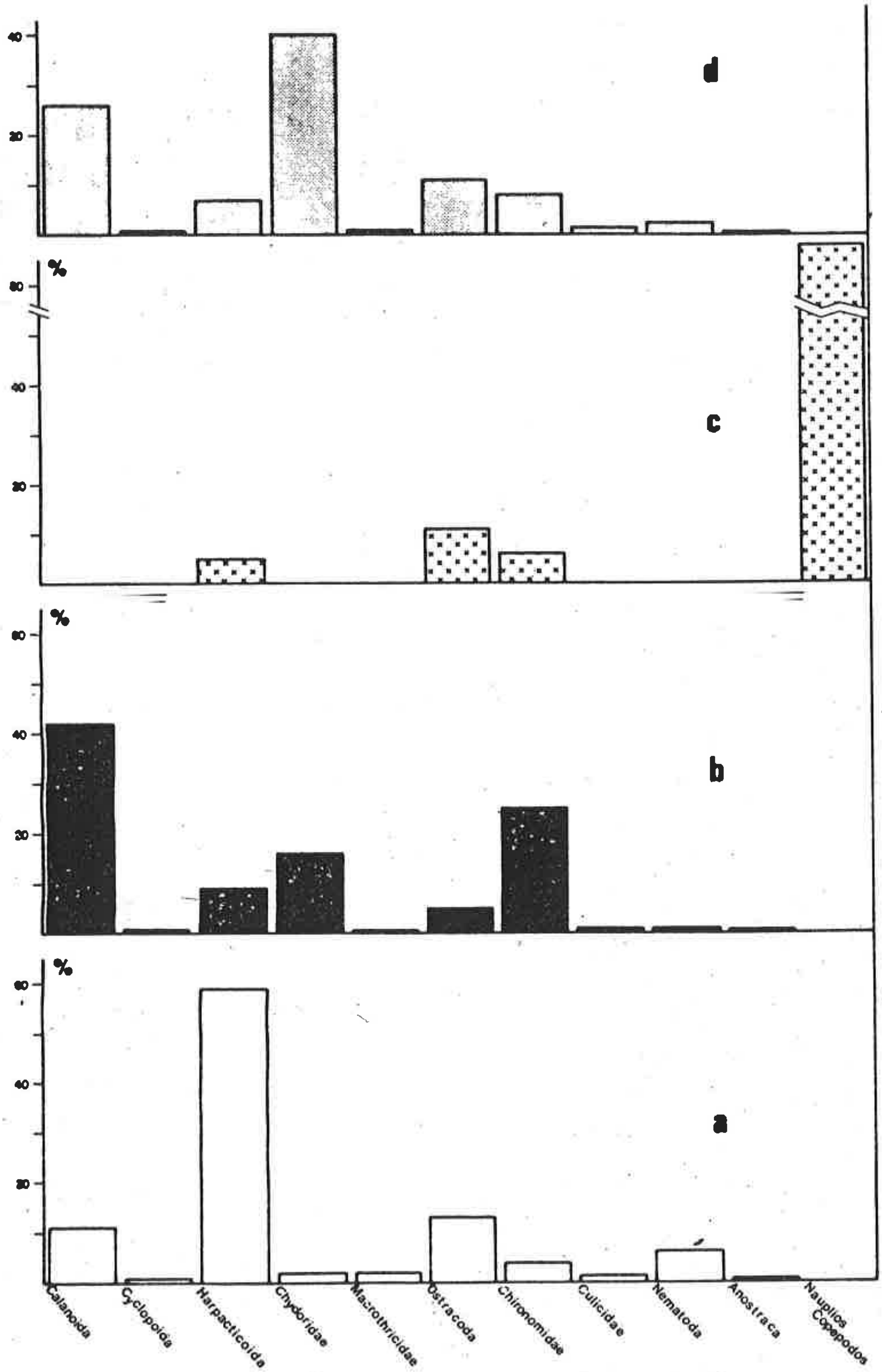

Fig. 3. Abundance trend of the main groups during the wet-frozen phase. a)before freezing./b)free water under ice./c)ice./d)pond after melting.

CONCLUSIONS

Some taxa respond remarckably well, passing quickly from dormancy to the normal active phase, as soon as the pond fills. These groups, mainly Ostracoda and Nematoda, spend the dry phase as mature forms deep in the mud. Other groups, especially Anostraca and Cladocera, spends the dry stage as resting eggs, that are viable for a long time and develop gradually after the pond is filled.

Data on cyclopoids and harpacticoids are insufficient to explain their survival during the dry stage and more information is needed.

Although some of the organisms trapped in the ice during the frozen phase are still viable after melting their number are not significant in comparison with the populations that remain in the free water under the ice-cap.

BIBLIOGRAPHY

ALONSO, M. & COMELLES, M. 1984. Apreliminary grouping of the small epicontinental water bodies in Spain and distribution of Crustacea and Charophyta. *Verh. Internat. Verein. Limnol.* 22: 1699-1704.

CAMACHO, A.I.; G.-VALDECASAS, A. & FERNANDEZ LOP, A. 1982. Contribución al conocimiento de los medios leníticos temporales de la sierra del Guadarrama. *Actas I Congres. Nac. Protec. Nat. y Medio Humano (in press).*

DANELL,K. 1981. Overwintering of invertebrates in a shallow northern Swedish lake. *Int. Revue Ges. Hydrobiol.* 66: 837-845

ELLIOT, J.M. 1971. Some methods for the statistical analysis of samples of benthic invertebrates. *F.B.A. Sci. Publ. 25.*

HARTLAND-ROWE, R. 1972. The limnology of temporary waters and the ecology of Euphyllopoda. In CLARK, R.B.& NOOLTON, R.J. (ed.): *Essays in Hydrobiology:* 15-31. Univ. of Exeter.

HOLMQUIST,CH. 1973. Some artic limnology and the hibernation of invertebrates and some fishes in subcero temperatures. *Arch. Hydrobiol. 72:49-70.*

LUND, J.W.G.; KIPLING,C. & LE CREN,E.D. 1958. The inverted microscope method of estimating algal numbers and the statistical basis of estimations by counting. *Hydrobiologia* 11:143-170.

OLSSON, T.I. 1981. Overwintering of benthic macroinvertebrate in ice and frozen sediment in a North Swedish river. *Holartic Ecology* 4: 161-166.

PENNAK, R. W. 1978. Freshwater invertebrates of the United States. *J. Wiley & Sons.*

WIGGINS, G.B.; MACKAY, R.S. & SMITH, J.M. 1980. Evolutionary and ecological strategies of animals in annual temporary pools. *Arch. Hydrobiol.* 58: 97-206.